

METEOROLOGICAL DATA FOR MIDWAY ISLAND, NORTH PACIFIC OCEAN

A special meteorological station was established on Midway Island, N. lat. 28° 15', W. long. 177° 22', on May 1, 1917.

The instrumental equipment consists of a mercurial barometer, barograph, thermometers, anemometer, single register, and a rain gage, all standard instruments of the Weather Bureau pattern. A single observation is made at 6:30 p. m. daily, mean local time. This observation is cabled to Honolulu and thence to San Francisco, Calif.

Previous to the date above-mentioned observations of pressure and the direction and force of the wind were made at local noon and mailed to the Marine Division of the Weather Bureau in Washington, D. C. Through the cooperation of the chief of that division, Mr. F. G. Tingley, these earlier observations of pressure have been combined with the later ones, thus forming the series of 13 years of continuous observations presented in Table 1. Data for the other elements are confined to the period May, 1917, to December 31, 1924.—A. J. H.

TABLE 1.—Meteorological data for Midway Island, North Pacific Ocean¹

MONTHLY MEAN PRESSURE (INCHES)

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual
1912	29.87	30.04	30.18	30.24	30.14	30.08	30.03	30.01	30.00	30.00	30.07	30.07	30.061
1913	29.94	30.00	30.08	30.08	30.05	30.08	30.11	29.97	30.01	29.92	30.07	30.09	30.033
1914	30.15	29.99	30.19	30.17	30.22	30.13	30.09	29.96	29.87	30.03	30.09	30.10	30.089
1915	30.15	30.19	30.03	30.18	30.03	30.08	30.01	29.99	29.92	29.97	30.18	30.07	30.087
1916	29.81	29.85	29.99	30.13	30.11	30.05	30.07	30.07	29.96	30.00	30.06	29.89	29.999
1917	29.90	30.05	30.08	29.95	30.08	30.17	30.17	30.16	30.14	30.03	30.13	29.85	30.041
1918	29.94	30.05	30.08	30.18	30.11	30.07	30.06	30.05	29.97	30.04	30.14	30.14	30.089
1919	29.94	30.10	30.09	30.05	30.15	29.96	30.14	30.11	30.02	29.88	30.06	30.01	30.088
1920	29.94	29.94	30.15	30.12	29.94	30.01	30.11	30.09	30.07	29.99	30.15	29.97	30.040
1921	30.14	29.90	30.13	30.13	29.98	30.10	30.12	30.06	30.02	29.88	30.07	30.04	30.051
1922	30.03	30.03	30.03	30.22	30.11	30.03	30.05	30.04	30.02	30.07	30.05	29.89	30.048
1923	30.02	29.94	30.09	30.11	29.97	30.02	30.01	30.05	29.94	30.10	30.05	30.20	30.042
1924	30.00	30.07	30.05	30.11	30.08	30.02	30.19	30.11	30.04	30.08	30.06	29.90	30.059
Means	30.001	29.996	30.084	30.128	30.075	30.064	30.089	30.059	30.006	30.015	30.091	30.017	30.052

¹ Prior to May 1, 1917, observations were taken at local noon. Commencing on date named the hour of observation was changed to 6.30 p. m. A correction of -0.04 inch, for diurnal variation, has been applied to monthly means prior to that date, the correction having been determined from the barograph record. All readings corrected for gravity.

MONTHLY MEAN TEMPERATURE (° F)

[Based on daily means from (max. + min.) ÷ 2]

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual
1917					70.4	75.7	76.3	78.3	78.2	74.1	71.4	67.2	
1918	66.5	64.6	65.6	69.9	72.5	75.8	78.6	78.0	77.6	73.6	70.5	69.6	71.2
1919	65.5	66.2	66.4	68.1	72.0	72.0	75.6	78.2	75.8	72.8	67.3	65.9	70.4
1920	61.9	62.2	63.7				79.2	78.3	79.0	75.2	72.6	68.9	
1921	66.2	64.6	65.4	68.2	70.5	78.0	77.2	78.6	79.0	75.6	72.6	67.7	71.8
1922	67.6	66.0	68.1	67.4	72.8	75.5	77.6	78.6	79.0	74.4	69.9	67.6	72.1
1923	65.7	64.4	64.8	68.2	71.1	76.4	78.0	78.4	77.4	74.4	69.7	66.0	71.2
1924	65.2	68.6	67.4	66.6	70.4	74.2	78.6	79.6	79.0	75.4	70.2	65.3	71.7
Means	65.2	65.2	65.9	67.6	70.8	75.1	77.6	78.5	78.1	74.4	70.5	67.0	71.4

WIND DIRECTIONS—NUMBER OF OBSERVATIONS (MAY 1917—DECEMBER 1924, INCLUSIVE)

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual
N	17	10	14	23	15	12	3	6	7	19	19	13	158
NE	38	29	49	90	84	72	111	113	83	114	75	45	903
E	24	14	35	42	36	30	67	85	43	37	31	19	453
SE	19	21	37	22	38	56	35	33	68	17	25	22	393
S	21	13	11	9	19	21	15	8	7	7	11	17	159
SW	43	48	30	5	14	18	8	0	12	14	24	44	260
W	20	21	12	8	19	13	6	2	10	18	19	35	183
NW	34	42	29	10	26	15	3	1	6	19	33	52	270
Calm	1	0	0	1	7	3	0	0	4	3	3	1	23
Total observations	217	198	217	210	248	240	248	248	240	248	240	248	2,802

MONTHLY PRECIPITATION (INCHES)

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual
1917					2.81	3.30	2.66	1.26	1.32	7.46	0.54	5.60	
1918	8.19	3.63	3.28	0.46	0.97	0.35	2.84	5.64	7.43	10.01	0.70	1.54	45.04
1919	0.76	2.30	5.42	3.40	0.53	3.87	1.57	0.04	5.44	2.83	0.70	1.52	28.38
1920	1.50	4.20	6.81	6.07	3.87	6.53	0.91	2.94	4.79	12.41	2.56	5.36	57.95
1921	1.27	6.05	2.84	5.11	6.43	0.54	8.22	2.76	3.65	5.50	1.61	2.65	46.63
1922	2.30	4.61	3.71	0.36	2.46	2.33	4.56	4.70	5.25	3.69	5.12	6.03	45.12
1923	1.12	3.99	3.52	0.96	12.59	2.86	4.33	4.14	7.41	0.85	1.72	0.46	43.95
1924	8.63	1.31	2.58	1.52	0.86	5.06	1.17	5.10	3.92	3.47	0.43	6.24	40.33
Means	3.40	3.73	4.02	2.55	3.82	3.10	3.28	3.32	4.90	5.78	1.67	3.68	43.25

MEAN MONTHLY WIND VELOCITY (m. p. h.)²

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual
1917					11.9	22.3	25.5	15.1	13.6	27.0	15.7	20.2	18.9
1918	16.5	20.0	23.2	19.5	15.3	11.3	13.4	16.4	15.8	18.3	21.9	16.7	17.4
1919	11.0	12.6	14.7	8.9	9.4	8.1	13.7	8.5	13.5	13.3	12.6	16.8	11.9
1920	16.5	18.0	12.1	11.7	12.3	9.3	11.7	10.5	10.8	10.1	13.2	17.5	12.8
1921	15.9	18.9	14.8	16.9	10.8	8.8	16.6	12.1	15.4	17.5	13.0	17.8	14.9
1922	15.5	20.0	16.7	15.4	13.4	12.2	13.1	11.8	9.0	14.7	17.5	19.0	14.9
1923	17.0	19.0	14.6	11.3	10.4	8.9	8.2	9.2	12.4	12.6	15.9	13.0	12.7
1924	14.0	14.1	12.8	14.5	10.5	8.8	12.8	11.3	6.8	15.3	13.5	18.5	12.7
Means	15.2	17.5	15.6	14.0	11.8	11.2	14.4	11.9	12.2	16.1	15.4	17.4	14.4

² Based on one observation daily.

THE DRY SEASON OF 1925 IN THE PANAMA CANAL ZONE

(Extracts from report by H. Z. Kirkpatrick, chief hydrographer, dated Balboa Heights, June 11, 1925)

Meteorologically, the dry season began about January 7 and ended about April 23, but it was preceded and followed by a transition period of several weeks' duration.

Dry season symptoms began to be noticeable by December 6 and continued rainy season conditions began about May 17.

The actual duration of dry conditions was slightly below the average; but from a water-supply standpoint, this season was the fourth driest in the last 14 years.

Comparative figures on the basis of length of time, season for the past 14 years are given in the following amount of rainfall, and Gatun Lake net inflow, on the dry Table 1:

TABLE 1.—Comparison of dry seasons since the formation of Gatun Lake, 1912 to 1925, inclusive

Stations	RAINFALL—INCHES													
	Dec. 1, 1911, to May 7, 1912, inclusive, 159 days.	Jan. 2 to Apr. 23, 1913, inclusive, 112 days.	Dec. 23, 1913, to Apr. 24, 1914, inclusive, 123 days.	Jan. 7 to Apr. 19, 1915, inclusive, 103 days.	Dec. 26, 1915, to Apr. 10, 1916, inclusive, 107 days.	Dec. 18, 1916, to Apr. 26, 1917, inclusive, 130 days.	Dec. 20, 1917, to Apr. 16, 1918, inclusive, 121 days.	Nov. 27, 1918, to Apr. 12, 1919, inclusive, 137 days.	Dec. 16, 1919, to May 13, 1920, inclusive, 150 days.	Dec. 8, 1920, to May 11, 1921, inclusive, 155 days.	Jan. 7 to May 4, 1922, inclusive, 118 days.	Jan. 4 to May 4, 1923, inclusive, 121 days.	Dec. 19, 1923, to Apr. 16, 1924, inclusive, 123 days.	Jan. 7 to Apr. 23, 1925, inclusive, 107 days.
	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Porto Bello.....	5.74	9.67	7.37						10.18	23.37	13.92	15.68	10.59	9.57
Colon.....	6.37	8.15	5.55	21.98	7.68	4.14	7.90	5.33	5.26	14.05	5.39	3.88	4.94	5.11
Gatun.....	10.30	10.85	5.46	25.14	7.09	3.62	10.20	4.92	3.37	13.16	7.41	4.77	6.23	7.87
Monte Lirio.....	9.29	6.63	6.50	16.13	6.76	3.43	9.63	7.14	2.41	14.96	4.75	4.03	7.33	4.47
Gambua.....	3.03	3.45	2.23	6.92	5.08	1.31	4.09	2.36	2.52	7.69	3.56	1.13	3.35	2.51
Alhajuela.....	1.03	1.23	1.43	7.54	2.41	1.67	2.24	1.52	1.78	5.81	1.22	1.33	2.17	1.83
Vigia.....	1.60	1.72	1.15	6.14	2.04	1.14	3.30	1.91	1.51	4.50	1.22	2.05	2.63	1.28
Culebra.....	3.85	2.93	.91	6.42	3.98	1.05	3.25	1.06	2.79	2.94	2.64	.66	2.44	1.31
Empire.....	3.20	2.66	.88	6.93	3.61	.75	2.57	1.73	3.02	4.38	1.69	.60	1.50	1.10
Pedro Miguel.....	6.29	1.14	3.17	3.24	3.04	2.92	7.27	2.00	6.15	4.60	5.64	.47	1.06	3.46
Balboa Heights.....	4.76	1.28	2.32	4.56	3.97	3.63	5.43	.93	4.46	10.64	3.69	1.96	.38	1.36

CORRESPONDING NET YIELD OF GATUN LAKE WATERSHED (C. F. S.)

	110	1,267	782	2,794	1,336	519	1,329	998	9	873	1,347	658	736	525
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¹ No accurate data for this dry season. Revised estimate using Chagres River discharge and comparing with other dry seasons.

Chagres River.—The Chagres River discharge at Alhajuela was 18 per cent below the 24-year, 4-month (January to April, inclusive) dry season average, or 1,028 c. f. s. against a mean of 1,251 c. f. s. The minimum discharge of the Chagres for the four months was 467 c. f. s. on April 24; the maximum discharge for the same period was 13,300 c. f. s. on January 3.

Gatun Lake.—Gatun Lake continued to fall, but to a lesser extent, during the transition period from dry to rainy conditions and the lowest point, 82.57 feet was reached on May 17. This represents a loss in storage of 20.67 billion cubic feet as compared with 14.60 billion cubic feet for last year and 24.42 billion cubic feet in 1920. The above figures are total storage losses from maximum lake height to minimum height.

Gatun hydroelectric carried full Isthmian power load during the dry period and used 15.86 billion cubic feet

from January to April, inclusive, while 9.03 billion cubic feet were the requirements for lockage water during the same period; i. e., ratio of 1.756 to 1.

A total of 1,598 lockages ($\frac{\text{Gatun} + \text{Pedro Miguel}}{2}$) were made during the four-month period, compared with 1,825 for last year and 1,572 for the same period in 1923. The requirements per through lockage per 24 hours were 65 c. f. s. for 1925, 72 c. f. s. for 1924, and 82 c. f. s. for 1923.

The saving at the locks during the four months, January to April, inclusive, amounted to approximately 0.45 foot on Gatun Lake.

Table 2 shows the net inflow into Gatun Lake for the dry-season months since the formation of the lake; Table 3 gives the hydrology of Gatun Lake for the four-month period, January 1 to April 30, inclusive, 1925.

TABLE 2.—Net yield in c. f. s., dry seasons of record, Gatun Lake ¹

	1912 ²	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	Average for month
December ¹	2,690	5,335	4,307	7,010	7,673	4,986	9,218	2,158	4,939	3,698	7,649	7,842	4,232	7,742	5,677
January.....	400	2,583	1,739	2,570	1,863	1,111	3,023	1,541	769	1,216	8,641	2,363	1,050	2,565	2,245
February.....	271	1,298	744	4,207	1,320	139	431	73	—287	951	1,482	698	1,041	601	926
March.....	—392	678	167	823	698	—182	36	—50	—335	—121	190	—84	98	—278	85
April.....	—363	567	308	5,400	1,076	447	1,119	3,250	—706	244	210	—185	2,303	652	1,028
May.....	2,771	4,992	3,219	6,111	4,063	4,635	7,964	4,352	583	2,109	4,605	2,825	4,754	1,792	3,912

¹ Net yield is the total yield minus evaporation on Gatun Lake.

² Estimated.

³ Decembers are of previous years; i. e., December, 1911, is in 1912 dry season.

TABLE 3.—*Hydrology of Gatun Lake watershed. Dry season 1925, January to April, inclusive*

[Drainage area, 1,320 square miles]

(Gatun Lockages, 1,542; Pedro Miguel Lockages, 1,655)

Gatun Lake		Elevation	Date
Monthly mean		85.28	
Maximum		87.10	Jan. 1
Minimum		82.97	Apr. 25

	Quantities	
	Million cubic feet	Second-feet
Gatun spillway, waste	1,788.2	172.5
Gatun spillway, leakage	37.2	3.6
Gatun Locks, lockages and tests	4,868.1	469.5
Gatun Locks, leakage	95.0	9.2
Gatun hydroelectric plant	15,857.6	1,529.5
*Pedro Miguel Locks, lockages and tests	4,163.2	401.5
*Pedro Miguel Locks, leakage	54.1	5.2
*Maintaining Miraflores Lake through Pedro Miguel Locks	0.0	0.0
Pumping at Gamboa	131.2	12.7
Brazos Brook Reservoir	211.6	20.4
*Pumping at Gaillard Cut	0.0	0.0
a. Total outflow	27,206.2	2,624.1
b. Storage (+increase, -decrease)	-17,936.5	-1,730.0
c. Net yield (a±b)	9,269.7	894.1
d. Evaporation (31.987")	8,359.5	806.3
e. Total yield (c+d)	17,629.2	1,700.4
f. Rainfall on lake (9.62")	3,634.3	350.5
g. Yield from land area (e-f)	13,994.9	1,349.9
*Transferred to Miraflores Lake	4,217.3	406.7

	Mean area, square miles	Rainfall, inches	Run-off, inches	Percentage, run-off
Lake surface	163.9	9.62	9.62	100
Land area	1,156.1	8.71	5.23	60
Total watershed	1,320	8.82	5.73	65

RIVER REGULATION

[Regulation of Rivers without Embankments, as Applied in the Training Works, at the Headwaters of the Rangoon River, Burma (locally known as the Myitnaka Training Works). By F. A. Leete, assisted by G. C. Cheyne]

In Nature, June 6, 1925, Mr. Brysson Cunningham presented a very interesting review of the above publication, and below are given the essential features thereof.

The basic proposition advanced is that a river may be left to effect its own training without the use of embankments of any kind, including all artificial aids to bank formation, with the exception of sticks of bamboo. The scene of operations was among the headwaters of the Rangoon River in Burma, used mainly for the transportation of teak logs. The streams are fed from torrents from the hills with an extreme altitude of about 2,500 feet, the annual rainfall varying from 60 to 120 inches. During the monsoon season high floods occur at frequent intervals, carrying immense quantities of sand and clay in suspension. At the foot of the hills the flood waters spread out over the plain submerging the paddy fields and producing a series of swamps, with the result that the teak logs were left stranded with much resulting loss.

Formerly embankments, at first high and then low, were constructed at great cost, but in 1917 came the inspiration that no embankments at all were necessary. It had been observed that soil deposits occurred around stranded logs and other debris; therefore a trial fence of bamboo stakes was made along the desired line of embankment. The method was simple. After the proposed line of channel had been pegged out, following the natural depressions as a rule, all growth was removed to

a width of 150 feet on each side of the line. One hundred feet on each side of the line, fences were made by driving into the ground pointed bamboos, 5 or 6 feet long, and about 9 inches apart, with the tops dressed to a steady slope, and about 3 feet above ground level. The stakes were lashed to a horizontal rail about 6 inches from their tops, with coir (coconut fiber) rope.

The outcome fully justified the original conception. The fences caught much small rubbish and formed a barrier checking the flow of the water. This check caused a deposit of the heavier sand particles on the streamside of the fence, while the finer particles were carried beyond it. The stakes (fence) became imbedded in the deposit, which gradually accreted to heights ranging up to 9 or 10 feet or even more. Thus natural embankments were formed and the river channel completely defined. When the first row of stakes is buried, a second row may be driven, but this is not often necessary. Finally the river bank becomes so high that the channel is large enough to carry the whole normal flood water. The forming banks serve as well to raise the level of the surrounding country, thus reclaiming considerable tracts for cultivation. Bad bends in the river are eliminated by short cuts.

The method is not one of universal application, but it is suitable in the case of streams originating as hillside torrents and heavily charged with detritus and sandy silt, chiefly in their upper reaches. Considerable variation in water level and frequent overtopping of banks in the early stages are features of the course of channel formation, and when these are lacking, the method can not be utilized, or at any rate, not so effectively.—H. C. F.

A CONCRETE RAIN-GAUGE SUPPORT

[Extracts from a memorandum by S. D. Flora, Weather Bureau, Topeka, Kans.]

An excellent form of support for a rain gauge that will last indefinitely consists of a cement block 12 inches square into which four gas pipes were inserted before the cement had set, so that the can of the rain gauge is held firmly by them, but with enough space so that it can be lifted out. The gas pipes project 21 inches above the cement.

The block need not, of course, be exactly of the size specified above. It is a good idea in practice to bury part of it so that the bottom of the gauge is held about 3 inches above the ground. The cost of this support should not exceed \$3.

METEOROLOGICAL SUMMARY FOR SOUTHERN SOUTH AMERICA, AUGUST, 1925

[Reported by Señor J. B. Navarrete, El Salto Observatory, Santiago, Chile. Translation by B. M. V.]

The month of August was relatively dry in the central zone of Chile and somewhat rainy in the south during the first 15 days. From the 2d to the 6th important atmospheric depressions crossed the southern region, causing general rains over nearly the whole of it. The maximum precipitation in 24 hours occurred on the 5th at Valdivia. On the 4th there were local rains on the high plateau of Bolivia and in the interior of Tacna Province.

On the 7th and 8th an anticyclonic center was established in the interior of the continent at latitude 40°, with a fall of temperature and fine weather.

From the 9th to the 12th there was a renewed development of atmospheric disturbances in the southern region; general rains occurred, and on the 11th heavy snowfall occurred in Magallanes Province.